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ABSTRACT

As information delivery systems on the Internet increasingly evolve into World Wide Web browsers, understanding key graphical elements of the browser interface is critical to the design of effective information display and access tools. Image maps are one such element, and this document describes a pilot study that collected, reviewed, and evaluated image maps from homepages of educational institutions. World Wide Web browsers offer a high level of interaction through hyperlinks, most of which involve text or a simple image. Image maps, on the other hand, are complex visuals that contain multiple hyperlinks to a number of information resources. Effective image maps offer clearly defined multiple links or "hot spots," present visual content that supports the theme or purpose of the site, permit backtracking and bookmarking, help the user build mental models of the interrelationships of information resources, do not take too long to load, and do not clutter the display. Researchers developed a survey form, for use by nine independent viewers, that sought to evaluate sites by those visual, navigational, and practical criteria. Fifty-five surveys on institutional homepages were collected from the nine viewers, and they revealed primarily that viewers placed a higher premium on simplicity than on pure visual appeal. Artistically captivating image maps often violated rules of simplicity; individual hot spots were hard to distinguish, choices were too multilayered to allow for a quick return to the starting point, and loading was slow. Reproductions of 11 institutional homepages accompany the text. Two other figures include a bar graph comparing average viewer ratings by site and a list of tips for image map design. (Contains 16 references.) (BEW)

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Visual Links in the World-Wide Web: The Uses and Limitations of Image Maps

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Introduction

The recent evolution of information delivery systems on the Internet into World Wide Web "browsers" like Netscape or Mosaic presents an exciting field for study in visual literacy. Such tools are rapidly becoming a major interest to small and large business concerns (Ellsworth, 1995) and may soon impact the nature of education in profound ways (Perelman, 1992). Understanding the visual characteristics of the image map, a key element in these new graphical interfaces to the Internet, is critical to the design of effective information display and access tools.

This study investigates the evaluations of different image maps selected from current home pages of educational institutions on the World Wide Web. Independent viewers and a survey form using criteria relating to visual literacy and hypermedia design were used to investigate the effectiveness of these image maps. This paper discusses research results relative to visual, navigational, and practical characteristics.

Literature Review

World Wide Web

As recently as the middle of 1993, the delivery of hypermedia modules over computer networks was problematic. A mechanism was needed that would standardize structural principles for the delivery of such modules and that would be "within the economic reach of ordinary users" (Howard, 1993). By the middle of 1994, exactly such a mechanism, the World Wide Web, had become available. Now, the full spectrum of communication tools is available electronically. Today many resources of hypermedia—integrated text, graphics, audio, animation, and video—are accessible across the World Wide Web (WWW).

The WWW is the fastest growing information tool on the Internet (Descy, 1994). Along with the rich multimedia communications, graphical web browsers also provide a very high level of interaction. Users can quickly jump to new, related information using interactive linking tools like "buttons."

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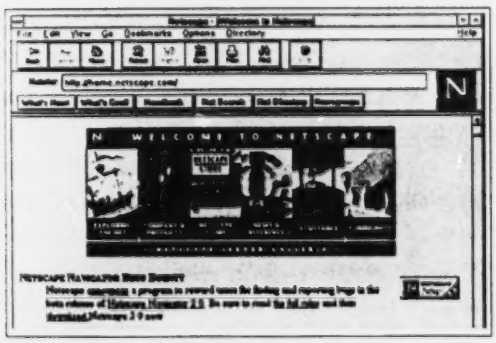
"hot words," or "image maps." These hyperlinks can connect users to new information resources on their own campus, within their own towns, or around the world with the simple click of a mouse button (Dougherty & Koman, 1994).

Image Maps

Graphics may be used to capture a viewer's attention, to hold interest (Grabinger, 1993), to supplement and reinforce textual materials (Lucas, 1991) or to provide organizational overviews of complex data (Grabinger, 1993), (Koneman & Jonassen, 1994). Likewise, in web browsers, graphics may just add visual interest, mark a simple link to related information, or indicate organized multiple links to a complex information set. In the WWW, these links are called hyperlinks.

Figure 1
Simple Graphic Links to Single Data Sets.
(http://vinny.csd.mu.edu/~howard/monet.html)

Figure 2
Multiple Links from One Image Map to Several Data Sets.
(http://home.netscape.com/)



A hyperlink is the connection between a word or graphic in an active browser view to another file *anywhere* on the World Wide Web (Hudak-David, 1994). A simple graphic hyperlink connects a single image to a single information resource (Figure 1). The *image map* (Figure 2) provides easy multiple choice access for web users. An image map connects a single, complex visual by multiple hyperlinks to a number of related information resources (www@trace.wisc.edu; Wiggins, 1994). A web browser recognizes when a user clicks a displayed "hot word" or "hot spot" and simply opens a connection to the pre-programmed uniform resource locator (URL - the Internet address of the desired resource). Currently, the image map is the most refined expression of this integration.

Image Map Design Issues

Effective image maps require careful design with respect to visual and interactive aspects as they pertain to the users. User interface design for image maps touches on three broad areas: visual characteristics, navigational characteristics, and practical characteristics.

Visual Characteristics

Visually, it is important that an image map be easily recognized as an image map. There should be visual cues that tell users they are dealing with an image map. The visual content presented in an image map should also support a typical viewer's

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expectations relative to the information the graphic is supposed to represent (Lucas, 1991). For example, an image map for a university in Arizona would probably not be designed around an arctic theme.

The individual graphics and related "hot spots" within an image map should represent the natures of the key informational segments. For instance, a book icon is a good representation for library services. Hot spots within an image map should be easy to recognize (Lucas, 1991; Jones, 1995). Often, a change in the mouse cursor will cue the presence of hot spots. In other cases, maps or similar structural features suggest the possibilities of hot spots. An image map should be artistic and visually appealing but not too busy or cluttered (Lucas, 1991; Jones, 1995; Grabinger, 1993).

Navigational Characteristics

Navigation is the act of recognizing and initiating a hyperlink to new information. Navigational aids should, if desired by the viewer, permit returning to the starting point in order to investigate other possibilities. Back tracking and book marking are additional navigational aids to help clarify the structure of multiple paths and provide quick repeated accesses to pertinent information (Desberg, 1994; Jones, 1995). Image maps should help users build mental models of the underlying structure and inter-relationships of information resources (Lucas, 1991).

Navigational pit falls such as dead ends, endless choices, or links to non-existent resources should be avoided. Links to non-existent resources are troublesome given how frequently web pages change. Finally, "help" should be available on demand or when "non-hot-spot" areas of an image map are clicked (Desberg, 1994).

Practical Characteristics

Practical concerns consider the implementation or working characteristics of image maps. An image map graphic should not take too long to load (Desberg, 1994) and the special effects (image overlay, fades, fonts, extraneous visual information, colors, 3D, animations, video, backgrounds) should not clutter the display or frustrate the viewer (Desberg, 1994). It should be easy to tell what resources have been visited in the current session with the image map (Jones, 1995). A visual consistency (Grabinger, 1993) should tie the image map and its related information resources together, cueing the viewer that he or she has not branched off into unknown or unexpected territories (Lucas, 1991). The graphics and the related information resources should fit the target audience (Desberg, 1994).

Methodology

Development of Survey Questionnaire

Since there is no previous research about image maps, this research represents a pilot study directed toward developing an evaluation procedure. Starting with guidelines from several computer-related product checklists in the literature (Lucas, 1991; Desberg, 1994; Cates, 1992; Tolhurst, 1992), the authors developed a 20 question survey form addressing design issues based on visual, navigational, and practical characteristics. Two initial surveys, conducted as a pilot for formative evaluation, determined changes and clarifications needed in the questionnaire. Following the pilot, the scale of evaluation was changed from 1-4 (strongly disagree to strongly agree) to 1-10 (ten step scale from disagree to agree) in order to clarify and strengthen the differences in viewer opinions.

Initially, questions were stated so that a high numeric response indicated strong agreement. However, some questions became awkward to read in this format. For example, one question stated "I was not frustrated by the image map." The authors were concerned the question could be confusing because of the non-typical negative structure so a few questions were re-phrased on the survey form. This sample question was re-written "I was frustrated by the image map." In this format, a response of 1 suggests a good image map.

Of the twenty questions, eight questions covered visual characteristics. For example, the questions ask how easy the graphic is to recognize as an image map, how noticeable the hot spots are, or how appealing is the image map. The navigational aspects, using seven questions, ask how easy it is to move from page to page, how easy it is to return to the starting point, or if help is available. Five questions cover the practical concerns such as how long graphics take to load, how consistent the graphics are at a particular site, or if the image maps are frustrating.

Selection of WWW Sites

The evaluation scope was limited to educational or institutional home pages on the WWW. The Net Directory option of the web browser Netscape 2.0 was the sampling source using the category of education. Two sites from each of 36 sub-categories of the educational area were randomly selected by the authors. While examining the 72 site options, the authors selected image maps that covered the spectrum from difficult to facilitative for typical users. Nine sites, (Figures 3 through 11) representing visual, navigational, and practical image map characteristics, were selected for the final evaluation by independent viewers.

Independent Viewers

Nine viewers were involved in this survey. Most of them are education graduate students taking instructional technology classes. Others were volunteers. They individually came to a computer station connected to the Internet and spent about one hour evaluating the image maps. Addresses of the nine sites and the survey form were given to the viewers and they usually decided which sites to evaluate out of the nine possibilities. Viewers' activities were observed by the authors during their evaluation time. Only two viewers finished evaluating all nine sites within an hour while one individual spent an hour and a half. Most of them evaluated four or five sites within an hour. Those who finished all nine sites within an hour were already familiar with the World Wide Web and image maps. Most viewers were quite new to the WWW and spent the first ten to fifteen minutes exploring. Those who were unfamiliar with the WWW were given some advice while exploring the image maps.

Results and Conclusions

Fifty-five surveys were collected from nine viewers. Each site was evaluated four to seven times by different viewers. For analysis, every question item has the same value system: the higher the score,

Figure 3
Discovery Channel Image Map.
(http://www.discovery.com/DCO/doc/1012/online.html)

Figure 4
Educom Image Map.
(http://www.educom.edu/)

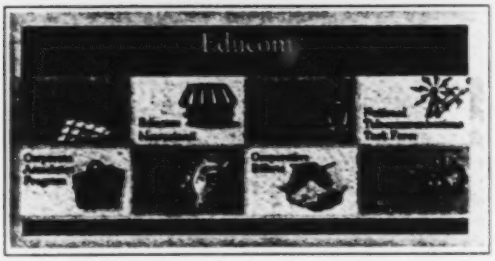

Figure 5
Excite Image Map.
(http://oberon.educ.sfu.ca:80/newhome.htm)

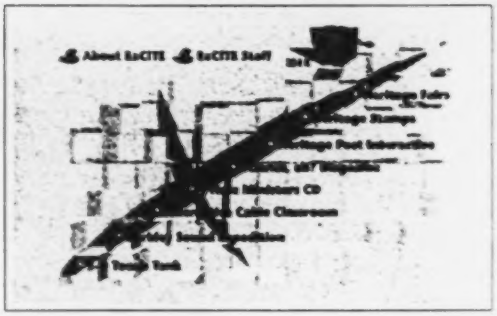

Figure 6
Paris Museums Image Map
(http://meteora.ucsd.edu/~norman/paris/Maps/MM)

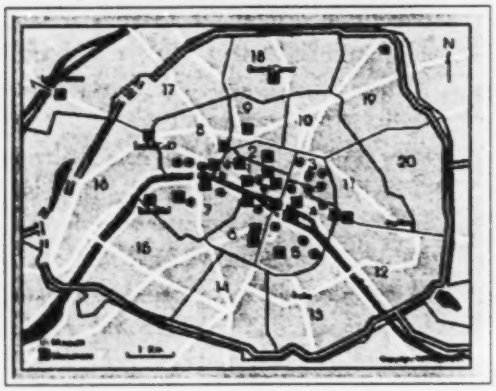

Figure 7
QuickTime Image Map.
(http://qtvr3.quicktime.apple.com/)

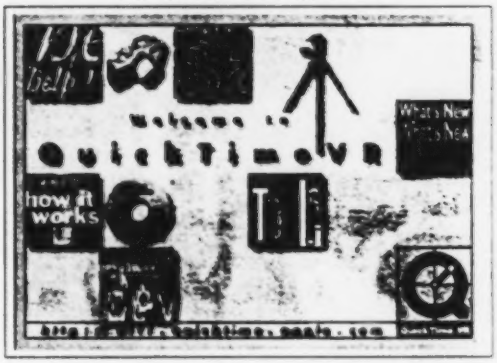

Figure 8
Texas A&M University Image Map.
(http://www.tamu.edu/test/map/map.cgi)

Figure 9
UCLA Image Map.
(http://www.ucla.edu/)

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Figure 10
University of Wyoming Image Map.
(http://www.uwyo.edu/)

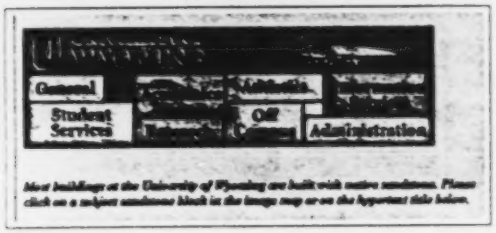

Figure 11
Virtual Tourist Image Map.
(http://wings.buffalo.edu/world)

the more positive the map characteristic. The 20 survey items were grouped into three categories: visual, navigational, and practical. Because each category reflects a different number of questions and a different number of viewer evaluations, the total score of each category was divided by the number of questions times the number of viewers in order to give a comparable weight to each category. Figure 12 shows the analysis of the data.

Overall Rankings

Overall, the image maps of UCLA (Figure 9) and Educom (Figure 4) were selected as the best. In visual characteristics, UCLA and Educom also claim the top two rankings. From a navigational perspective, the Virtual Tourist (Figure 11), the Texas A&M campus map (Figure 8), and the Educom image map occupy the top three spots in a very close ranking. Finally, from a practical viewpoint, UW (Figure 10) has the highest ranking. The UW result is supported by an independent study of nearly 500 college web pages conducted at Columbia University, which also considered visual and practical characteristics (Johnson, et. al., 1995). Their study highly rated the UW web page for good presentation of general information.

Visual Perspective

There seems to be two conflicting elements at work in the visual analysis. Image maps can be very artistic and complex or rather simple. When viewers are looking for direction to information, they appear to prefer simple image maps. Even when viewers were asked how visually appealing a graphic was, they seemed to judge the degree of appeal by how easily they could get to information. If they could quickly locate hot spots in the image map and if the icons accurately represented the information, they seemed to prefer the graphic. The UCLA (Figure 9) and Educom (Figure 4) image maps, which ranked the highest, both use a simple and well-grouped layout.

In Grabinger's study (1993), simplicity is one of the important factors in computer screen design. Besides simplicity, Lucas (1991), in a study about effective computer-learner interfaces, states that grouping has a very strong influence on commanding and focusing viewer attention. As counter-examples, Quicktime (Figure 17), Excite (Figure 5), and Discovery (Figure 3) present more artistically interesting image maps. However, these three all violate the rules of simplicity and united grouping. For instance, the Quicktime image map scatters

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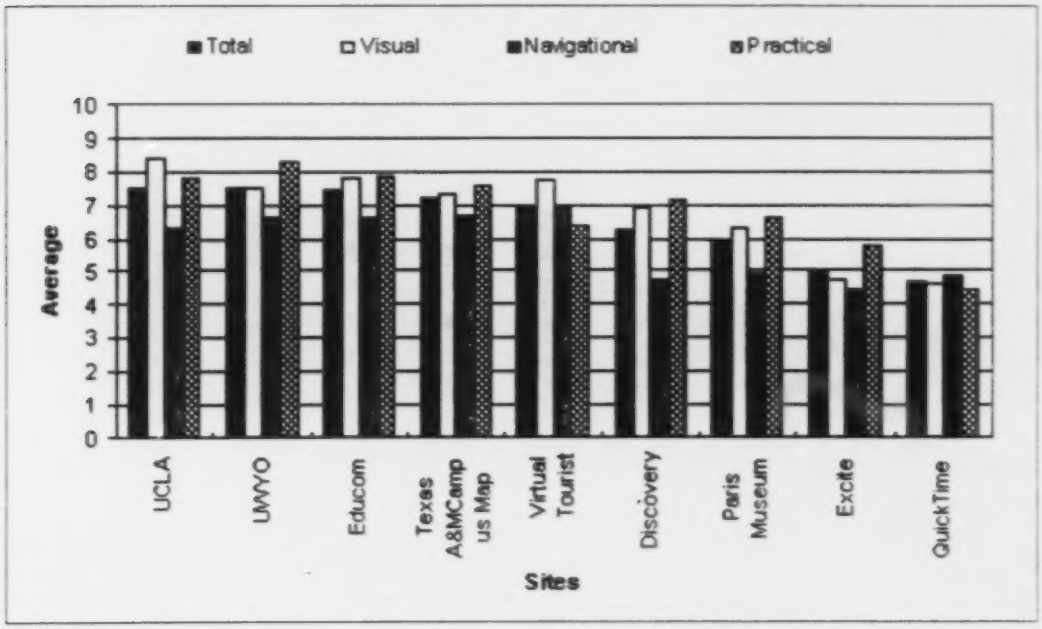
Figure 12
Comparison of Average Viewer Ratings by Site: Overall, Visual, Navigational, and Practical.



hot spots all around the graphic which defocuses or scatters viewers' attention and results in the lowest visual ranking. The Discovery and Excite image maps appear to override marginal grouping with a too complex image.

Navigational Perspective

Navigation deals with the mechanics of moving through the available information. Regarding navigational aspects, the Virtual Tourist (Figure 11), Texas A&M campus (Figure 8), and Educom (Figure 4) image maps were selected the best. These sites do not give the viewers many layers of choices. Thus, it is easy to link out in a single step and quickly return to the starting point. The high ratings for the Virtual Tourist and Texas A&M image maps may also be a function of the physical nature of the information they represent. Grabinger (1991) suggests that viewers prefer screens designed to closely reflect the content of the subject matter.

Practical Perspective

As to practical aspects, UW (Figure 10), Educom (Figure 4), and UCLA (Figure 9) ranked highest. Typically, these image maps are smaller and load quickly. Special effects are minimal. Consistency is a strong characteristic of these image maps and their related information pages. The linking pages have visual cues such as icons or graphics very similar to the original image map. These maps were also highly rated in visual criteria, suggesting practical characteristics may be correlated with visual characteristics. Artistic images, such as the Discovery or QuickTime image maps (Figure 3, Figure 7), tend to be large, complex and slow to load.

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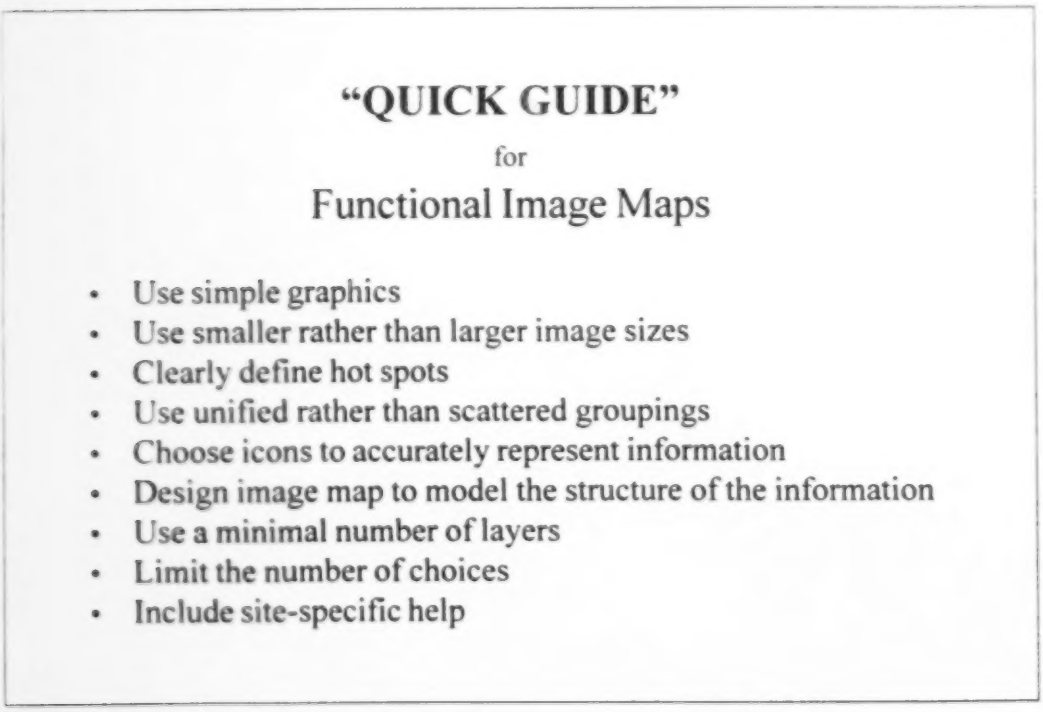
Discussion and Recommendations

This pilot study presents a number of factors that appear to be important to effective image map design when a viewer's purpose is to locate specific information. In this instance, functionality is the most important aspect. Simple graphics that load quickly and clearly designate hot spots appear to be preferred by the viewers in this study. Viewers, particularly novices, also wanted some site-specific help available when navigating web sites. Figure 13 presents the authors' recommendations as a "quick" guide for designing effective image maps for informational purposes. The Educom (Figure 4) image map, which placed somewhere in the top three rankings in each category, is the best example of these recommendations.

There may be different design guidelines when entertainment is the purpose of the image map. There is an interesting tension between artistic and functional aspects of image map design. A web designer must consider the balance between the purposes served by the maps and the intentions of the prospective viewers. From this research, viewers seeking information want functional, simple maps but viewers "surfing the web" may pass over such simple maps for the more artistic and entertaining images. The challenge to the image map designer is to find the balance between artistic needs to catch the viewer and functionality to allow the viewer to find information quickly. This balance issue presents opportunities for future research.

Figure 13
Summary Design Guide for Functional Image Maps.


"QUICK GUIDE"
for
Functional Image Maps
• Use simple graphics
• Use smaller rather than larger image sizes
• Clearly define hot spots
• Use unified rather than scattered groupings
• Choose icons to accurately represent information
• Design image map to model the structure of the information
• Use a minimal number of layers
• Limit the number of choices
• Include site-specific help

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